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Description of a new species of *Myelobia* Herrich-Schäffer (Lepidoptera, Pyralidae s.l., Crambinae) from Nicaragua feeding on cultivated bamboo, *Guadua aculeata* Rupr. ex E. Fourn. (Poaceae)

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Abstract. *Myelobia nicaraguensis* Landry & Maes, **sp. n.** was discovered in eastern Nicaragua. The caterpillar feeds on *Guadua aculeata* Rupr. ex E. Fourn. (Poaceae). Brief biological notes and detailed descriptions of the adult, larva, and pupa are provided as well as part of the CO1 mtDNA barcode. This represents the first pupal description and the first detailed and illustrated description of the larva for the genus *Myelobia*. The immatures of *M. nicaraguensis* and *M. smerintha* are briefly compared and the systematic position of *Myelobia* within the Crambinae is also discussed.

Resumen. *Myelobia nicaraguensis* Landry & Maes, **especie nueva**, fue descubierta en el este de Nicaragua, en la región de El Rama. La larva se alimenta de *Guadua aculeata* Rupr. ex E. Fourn. (Poaceae). Se incluyen algunas notas sobre la biología de la especie, además de la descripción de larva, pupa, adulto y el código de barras de ADN CO1. La descripción de la pupa y la descripción detallada e ilustrada de la larva son las primeras del género *Myelobia*. También se comparan los estadios inmaduros de *M. nicaraguensis* y *M. smerintha* y se discute la posición sistemática de *Myelobia* adentro de la subfamilia Crambinae.

Key words: Lepidoptera, Pyraloidea, Pyralidae, Crambinae, *Myelobia*, new species, *Myelobia smerintha* (Hübner), Nicaragua, bamboo, egg, larva, pupa

Introduction

Bamboo has recently been used in Nicaragua to recover exhausted or totally deforested cattle ranches. At the same time, there is an economic interest in producing wood from bamboo to cover soil and rapidly create a newly forested landscape. Besides protection of the soil against erosion, bamboo provides shelter for some wild animals because this crop is grown organically.

One of the most important concerns in any organic production system is the control of pests. At present, three main species of Lepidoptera were reared from larvae attacking the bamboo *Guadua aculeata* Rupr. ex E. Fourn. (Poaceae), a native species, in the El Rama area of Nicaragua. A leaf-rolling pyralid was identified as *Salbia* (Pyralidae: Spilomelinae), probably an undescribed species (A. Solis, pers. comm.). Two borers were also reared, a stem borer in the family Pyralidae attacking mostly woody stems and branches, and a shoot borer in the family Erebidae damaging the young emerging culms. The erebid species was identified as a probable new species in the genus *Scolecocampa* Guenée (Erebidae: Scolecocampinae; M. Pogue, pers. comm.). At least one species in this genus is known to be a pest on sugarcane in Mexico (Pogue 2002), a plant related to bamboo. This suggests the new species from Nicaragua with similar biology might become a potential pest of bamboo in the future. The third species, a stem borer, was the most common of the Nicaraguan bamboo feeders. It was identified as a new member of the Neotropical genus *Myelobia* Herrich-Schäffer (Pyralidae: Crambinae) by BL based on a comparison with the types or

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original descriptions of the 21 known species of *Myelobia*. Species of the genus are known to feed on sugarcane and other related grasses such as *Chusquea*, *Gynerium* and *Merostachys* (Zhang, 1994). Because *Myelobia smerintha* (Hübner, 1821) feeds on bamboo and occurs from Mexico (Dyar, 1917) to South America (S. Passoa, unpubl. records), and very likely in Nicaragua, it potentially could be confused with *M. nicaraguensis*. Therefore, we provide comparative notes on this species as well. Detailed morphological information on other *Myelobia* species is not available. We have not encountered larvae of *Splendeuptychia kendalli* Miller, 1978 (Nymphalidae: Satyrinae), the only butterfly recorded from *G. aculeata* in Latin America by Beccaloni *et al.* (2008). Caterpillars in the families Erebidae, Noctuidae, Hesperiidae, Nymphalidae, and Pyralidae (not identified further) eat *Guadua paniculata* Munro in Costa Rica (Janzen & Hallwachs, 2009).

Material and methods

Adults of *M. nicaraguensis* were reared from branches of *Guadua aculeata* bamboo, most of which were between 1 and 2 cm in diameter. All branches were cut in sections of 15 to 25 cm length containing at least one complete stem internode. We used segments already occupied by a larva, but also allowed caterpillars to enter undamaged fresh stems when needed. All the branches were set in a big plastic box with cloth on the bottom to permit 100 % humidity while avoiding the accumulation of standing water in the bottom of the box. This container was checked each morning and afternoon for adult emergence. Once we were familiar with the adult coloration, we collected additional moths with a mercury vapour lamp.

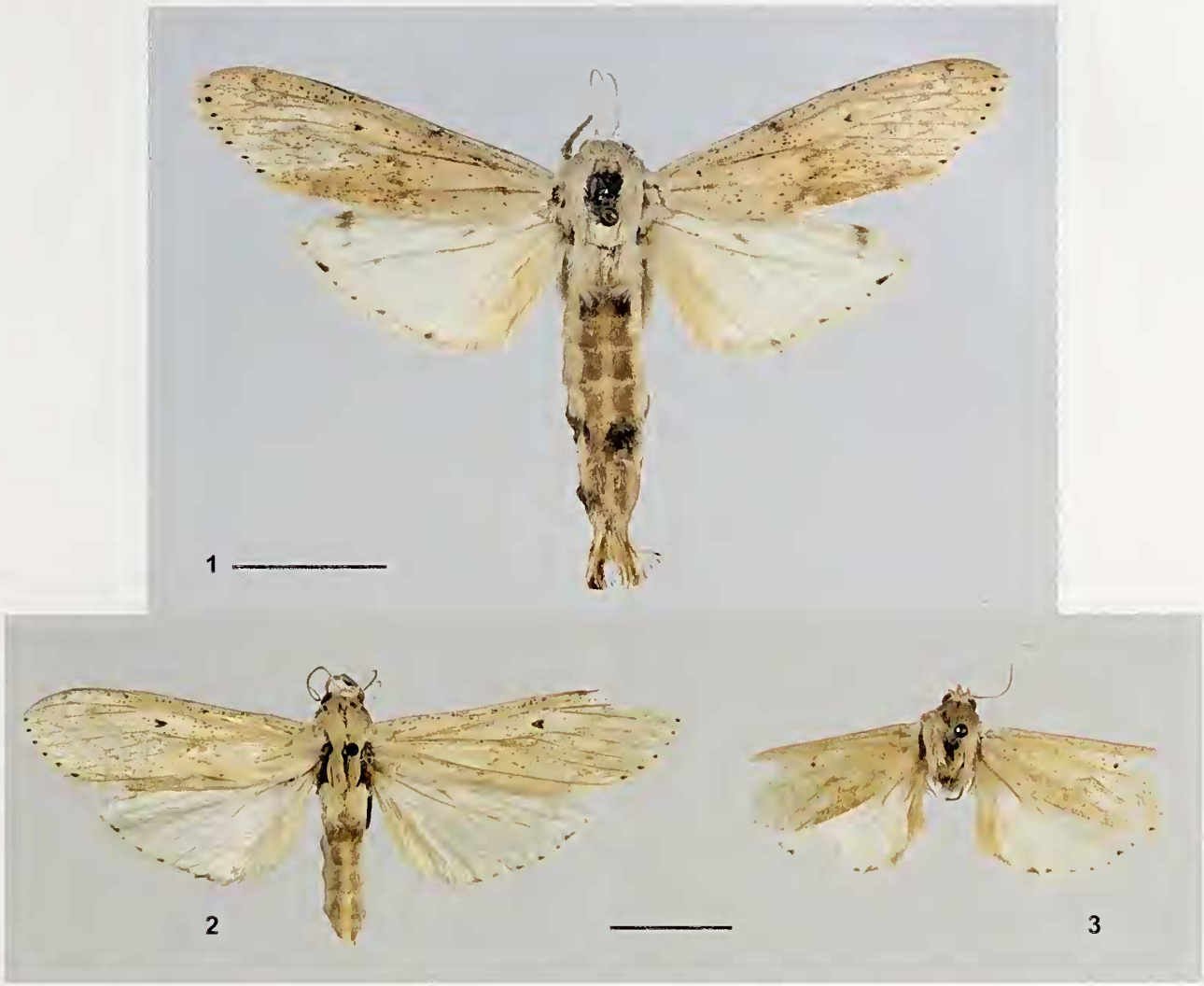
Photographs of the immature stages were taken with a Leica DFC 425 camera mounted on a Leica M205C dissecting scope. They were stacked using Zerene Stacker and enhanced with Adobe Photoshop Elements. Drawings were made with a camera lucida mounted on a Wild M10. One middle instar larva and a pair of adult abdomens were dissected after maceration in KOH at 60°C for one hour. They were then stained with chlorazol black and orange G, the latter mixed in lactic acid, and mounted in Euparal.

Our classification follows Landry (1995) who recognizes only one family (Pyralidae s.l.) instead of two (Crambidae and Pyralidae s. str.) in Pyraloidea (see also Regier *et al.*, 2012). Adult terminology follows Landry (1995) except for the use of 'phallus', instead of 'aedeagus', as recommended by Kristensen (2003). Color names are matched to Wikipedia (shades of brown, white, and yellow). Pupal terminology follows Mosher (1916). Larval morphology and setal nomenclature follows Stehr (1987), as applied to the Crambinae by Allyson (1986). Mandible terminology follows Passoa (1985) (see figures in Gilligan & Passoa, 2014: mandible morphology).

Only one mature larva of *M. nicaraguensis* was available for study. If a seta was broken on both sides of the body, the drawings record them by using of a pair of oblique crossbars to show the break. On the larval head, only the visible sockets of the MD setae of Stehr (1987) are shown. The broken antenna is shown with dotted lines. The larval mandible is illustrated from a probable 3rd instar (given its length) as we decided not to dissect the single mature larva of *M. nicaraguensis* associated with the type series.

The following acronyms are used: EAPZ for 'Escuela Agrícola Panamericana Zamorano', Francisco Morazán Department, Honduras; MELN for 'Museo Entomológico de León', León, Nicaragua; MHNG for 'Muséum d'histoire naturelle de Genève', Geneva, Switzerland; SMTD for 'Museum für Tierkunde, Senckenberg Naturhistorische Sammlungen Dresden,' Germany; SPIC for S. Passoa insect collection, Columbus, Ohio; USNM for National Museum of Natural History, Washington, D.C., U.S.A.

The molecular work was performed at the SMTD. DNA was extracted from a dried abdomen with the NucleoSpin Tissue kit of Macherey-Nagel according to the manufacturer's protocol and labelled as LEP2311. PCR amplifications were performed with the Bio-X-Act Short Taq DNA polymerase and the primers HybLCO (forward) and HybPat (reverse) following the methods of N. Wahlberg's lab (http://nymphalidae.utu.fi/Nymphalidae/Molecular.htm) with the following modifications in the initial mix: H20 (14.65 µl), MgCl2 (0.75 µl), both primers (0.5 µl), Bio-X-Taq (0.2 µl). The PCR program was that of Wahlberg's lab with the following changes in the cycles: denaturation temperature (94°), annealing time (40s). PCR products were analysed with a 1% agarose gel electrophoresis subsequently stained with GelRED and photodocumented under UV light. The clean-up of the PCR products was done with the ExoSAP-IT kit (USB Corporation) by mixing 0.1 µl ExoSap with 1µ H20 to 10µl of each PCR product. Samples for sequencing were prepared for each sequencing primers T3 and T7 as follows: 3 µl PCR product, 4.5 µl H20 and 2.5 µl primer (10 pmol/µl). The samples were sent to Macrogen Europe and further sequenced there. The forward and reverse sequences were aligned by eye and compiled under PhyDE 0.9971 (Müller et al., 2011). A comparison of the sequence with other COI barcode sequences was done on the BOLD Identification System (IDS)



Figures 1–3. Holotypes of *Myelobia* species. **1.** *Myelobia nicaraguensis* sp. n. **2.** *M. systrapega* (Dyar). **3.** *M. heinrichi* (Box). Scale = 1 cm.

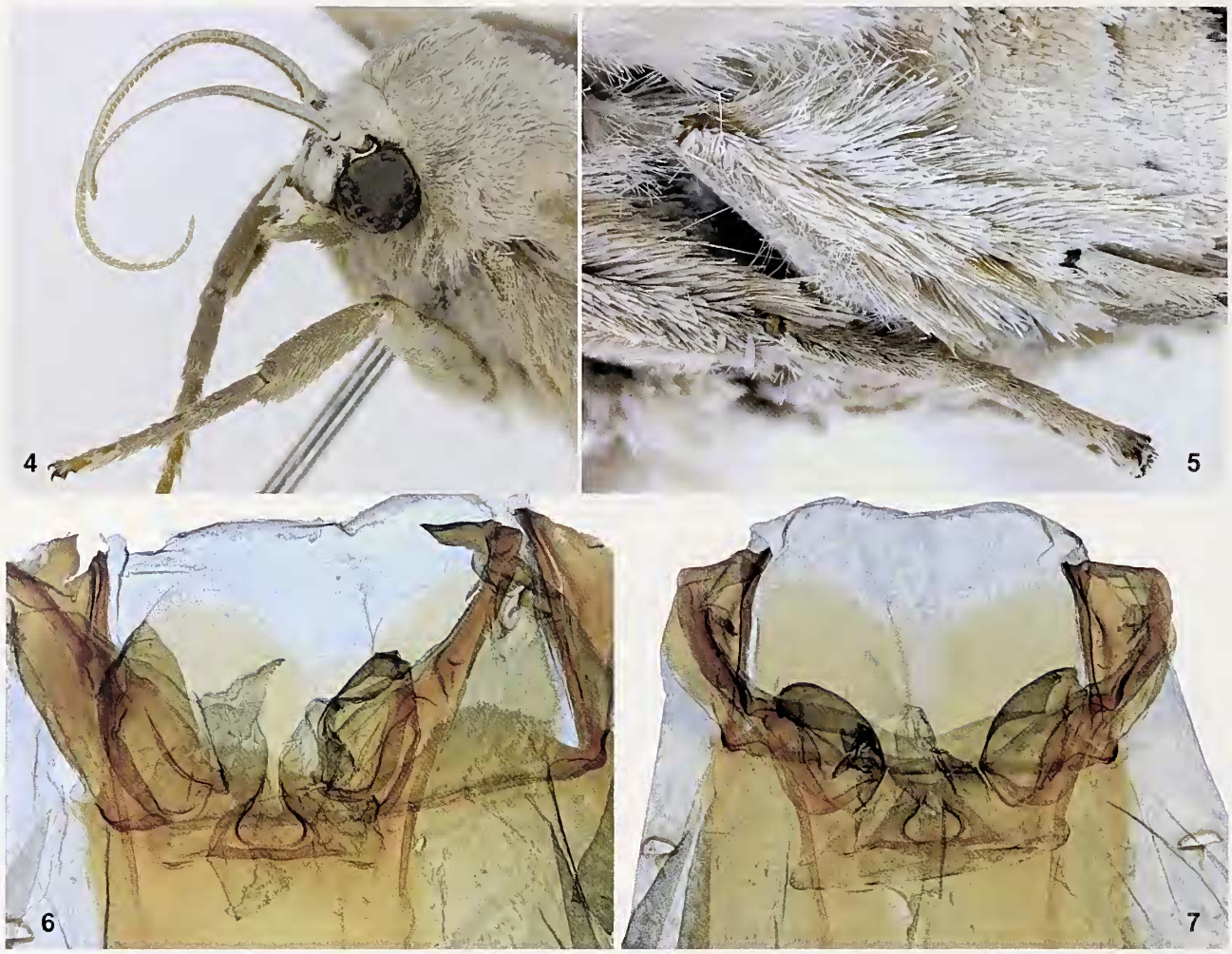
(Ratnasingham & Hebert, 2007). The sequence was aligned to the database with BLAST. The similarity of the barcode sequence with the sequences from BOLD was assessed using the Kimura 2-P parameter.

Myelobia nicaraguensis Landry & Maes, sp. n.

ZooBank LSID urn:lsid:zoobank.org:act:15ECC06B-83AF-455C-AD44-4C5F86176514

Diagnosis. This species (Fig. 1) is most similar to *M. systrapega* (Dyar, 1913; Fig. 2), described from Veracruz, Mexico, and *M. heinrichi* (Box, 1931; Fig. 3), described from Peru. In size, color and wing pattern all three species are very much alike. One possible difference is the smaller dark spot at the end of the forewing cell in *M. nicaraguensis*. The forewing of *M. nicaraguensis* is also darker and the hind tibia is more densely set with longer scales than in *M. systrapega* or *M. heinrichi*. However, the primary types of *M. heinrichi* and *M. systrapega* are both somewhat damaged and the holotype of the former is missing about one fourth of both forewings. Differences in forewing color intensity may be due to the age and partial deterioration of the type specimens of both *M. systrapega* and *M. heinrichi*.

The uncus of the male genitalia provides the best diagnostic characters. Its dorsal margin forms a sharp (ca. 130°) angle between the helmet-like distal section and the basal shaft in *M. nicaraguensis* (Fig. 9) while this angle is less pronounced (105°) and broadly rounded in *M. systrapega* (Fig. 12). There is no bend between these two structures (180°) in *M. heinrichi* (Fig. 15). As best shown by the illustrations, the shape of the apical margin of the uncus also differs and a flange is present ventrally in *M. nicaraguensis* and *M. systrapega*, but not in *M. heinrichi*. Also, the lateral margins of the shaft of the uncus are produced into a triangle pointing ventrally just before the distal section in *M. nicaraguensis* and *M. systrapega* while this triangle is closer to the middle of the shaft in *M. heinrichi*. In addition, the apex of the gnathos is blunt in *M. nicaraguensis* while it is pointed and distinctly upturned in the other two species. The lack of material has prevented us from diagnosing female specimens.



Figures 4–7. Morphological features of *Myelobia nicaraguensis* sp. n. **4.** Head of male. **5.** Hindleg of male. **6.** Female tympanal organs. **7.** Male tympanal organs.

Material examined: Holotype ♂ (Fig. 1): 1- 'Nicaragua: Bluefields: | Finca Rio Kama | UV Light – X-2013 | Col. J.M. Maes'; 'HOLOTYPE | Myelobia | nicaraguensis | B. Landry & J.-M. Maes'; 'MHNG | ENTO | 00008724'. Undissected and deposited in MHNG.

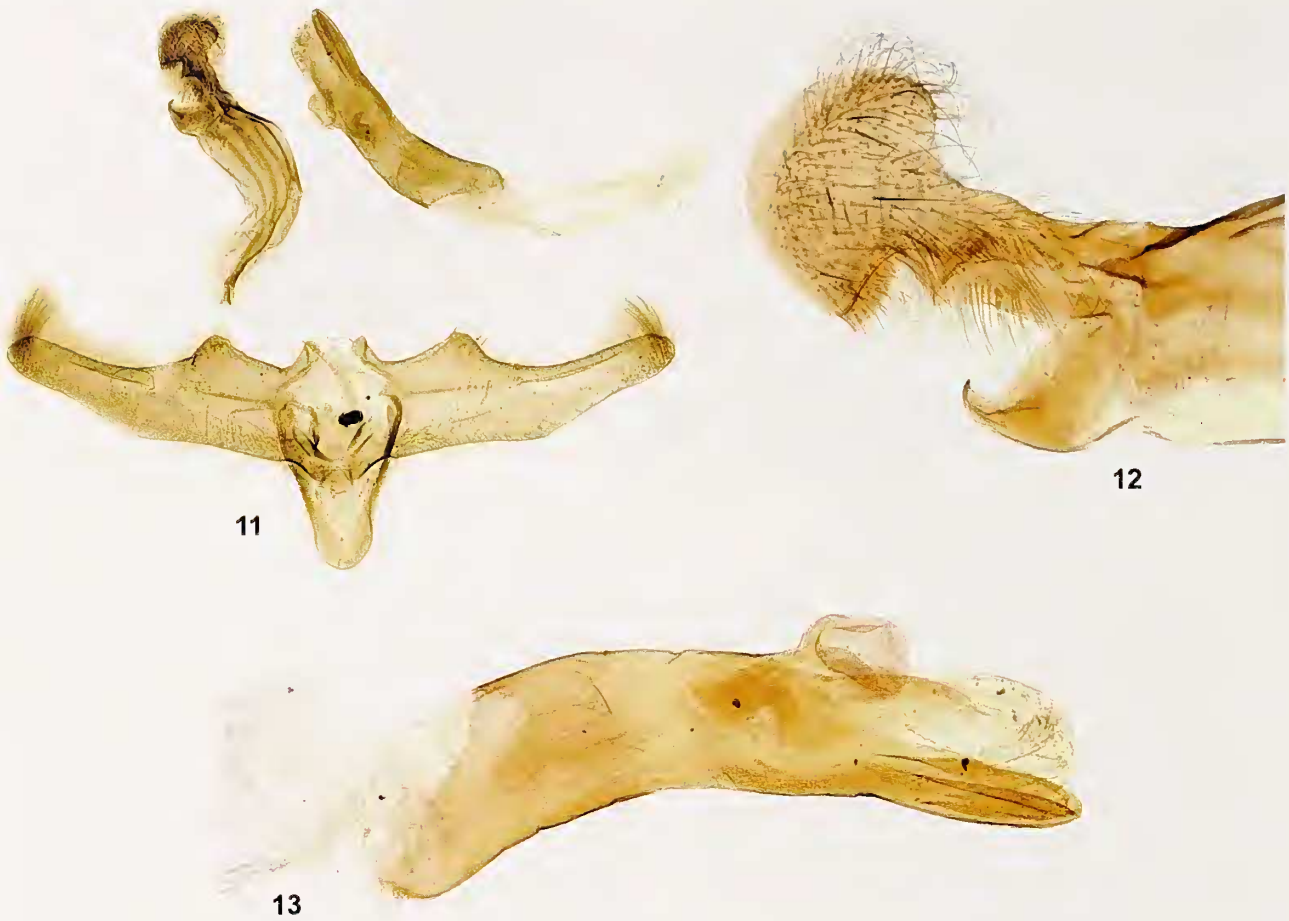
Paratypes, all from Nicaragua: 3 ♂ (one dissected, genitalia slide MHNG ENTO 8723), 1 ♀, same data as holotype; 15 ♂, 2 ♀, same data as holotype except date, 24–30.ix.2013; 3 ♀, Bluefields, Finca Rio Kama, ex larva from *Guadua aculeata*, 6.x.2013 (J.M. Maes); 2 ♀, idem, 17.x.2013; 2 ♀ (one dissected, slide MHNG ENTO 8722), idem, 18.x.2013; 1 ♀, idem, 22.x.2013. Deposited in EAPZ, MELN, MHNG, SPIC, USNM. Specimens were collected at light at a farm house, 12°14'55" N, 84°00'53" W, elevation 20 m, while others were reared from larvae collected in plantations in an area up to 3 kilometers away from this farm house.

Description. Male (n=19). Figs. 1, 4, 5, 7–10. Head (Fig. 4) white to old lace towards occiput, with some light tan in middle of vertex, lighter still on fronto-clypeus. Labial palpus only slightly longer than widest diameter of compound eye, fallow to tan. Maxillary palpus tan on first two palpomeres, white on third, with apical scales directed medially, forming extended, flattened surface. Proboscis scales white. Antennal scales white; flagellomeres serrate, with sensilla trichodea about 0.5 X (near apex of flagellum) to 0.33 X (toward base) width of corresponding flagellomere. Thorax old lace at base, ivory towards apex; with large lateral bunch of thin scales extending posteromedially over first abdominal tergite from each side of metathorax. Foreleg tan, with taupe band along femur medially, light taupe at tip of distal tarsomere. Midleg tan, with thicker scaling on dorsal edge of tibia, light taupe at tip of distal tarsomere. Hindleg (Fig. 5) tan, femur dorsally set with longer and thin projecting white to light tan scales, ventrally lighter, tip of distal tarsomere light taupe. Forewing length: 21–25 mm (holotype, 25 mm); forewing color wheat, sprinkled with blackish brown scales; main markings a small blackish brown spot at end of cell, a slightly larger dark greyish brown diagonal spot submedially on costa, a zigzagged diffuse submedian line below cell connected to even fainter zigzagged line from below cell to before middle of R5, a faint and thin, subapical greyish brown zigzagged line, with external points between veins, slightly darker below costa, and seven apical blackish brown spots between veins; fringes wheat with small greyish brown spots at level of apical spots. Hindwing ivory with light wheat hair-like scales in anal sector and along veins; markings greyish brown as small, light dash submedially in cell, subapical line distinct only

Figures 8–10. Male genitalia of *Myelobia nicaraguensis* sp. n. **8.** Whole genitalia except phallus. **9.** Close-up of uncus. **10.** Close-up of phallus with vesica partly everted.

toward costa, and darker, more or less elongate spots on outer margin between veins; fringes ivory, spotless. Abdomen dorsally: first tergite with white to chocolate scales medially, laterally with bunch of light tan hair-like scales extending posteriorly over tergite II and curving medially; second tergite mostly coyote brown, apicomedially with wheat to earth yellow; remaining tergites with pair of longitudinal tan bands apically bordered light wheat on each tergites, with median longitudinal band wheat colored; apex of abdomen with bilobed tuft of elongate, thin scales wheat and tan; laterally and ventrally light wheat with narrow median, tan longitudinal band ventrally, reaching last sternite before genitalia. Tympanal organs (n=1). As described for the genus by Landry (1995), but praecinctorium short, triangular, and not distinctly bilobed (Fig. 7).

Male genitalia (n=1). Figs. 8–10. Uncus large; dorsal margin between laterally compressed, helmet-like distal section and basal shaft sharply angled at about 130°, apical margin more narrowly rounded at dorsal angle, almost straight towards ventral angle, ventrally with bilobed flange; lateral margins of shaft ventrally produced into triangles just before distal section. Gnathos short and stout, with lateral arms forming ca. 110° angle with ventral margin of distal section; apically with short projection at about 45° from ventral margin; dorsally towards apex with thickly sclerotized denticles. Tegumen with narrow arms forming right angle with dorsally closed, larger distal section. Valva simple, narrowing to 0.4 times basal width; dorsal margin with triangular, narrowly rounded projection at 1/4; ventral margin with short, broad bulge near middle, then slightly angled upward; medially at apex with group of thickened setae. Juxta with main, median part short, narrowing towards apex, apically truncated; with lateral projections symmetrical, narrow, slightly down-curved, apically pointed, about 1/3 longer than median part, reaching base of costal triangle of valva. Vinculum arms narrow, with short, apically rounded saccus about 3/4 length of lateral arms. Pseudosaccus a short, rounded, convex plate with apex rounded and base ending in short point. Phallus slightly down-curved, width about



Figures 11–13. Male genitalia of *Myelobia systrapega* (Dyar) lectotype (USNM). **11.** Whole genitalia. **12.** Close-up of uncus. **13.** Close-up of phallus.

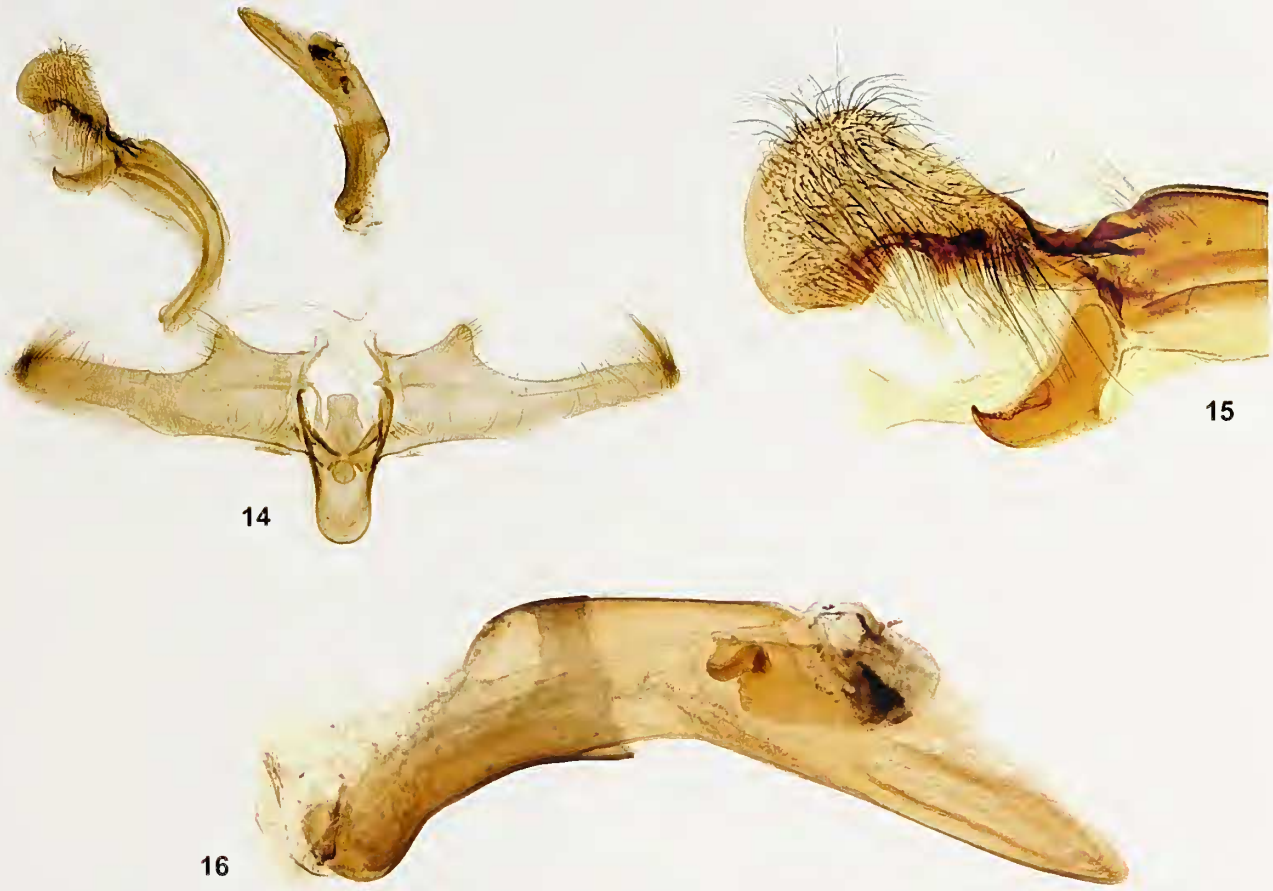
15% length, open dorsally on distal 1/3; without coecum penis; ductus and bulbus ejaculatorii almost four times as long as phallus shaft; vesica everting dorsally, with separate basal rounded flap proximally, covered with microscopic setae; single cornutus short, dagger like, with rounded base most thickly sclerotized.

Female (n=2). Forewing length: 25–31 mm; frenulum with four acanthae, the dorsal two shorter and thinner. Tympanal organs (n=1) as in male except praecinctorium more strongly developed and slightly bilobed (Fig. 6). Posterior margin of sternite VIII with rounded emargination covering more than half of width of sternite, with thicker cover of short, narrow scales along emarginated area.

Female genitalia (n=1) (Fig. 17). Papillae anales connected dorsally, narrow, with dense row of long setae all along apical edge, with dense cover of small, fine setae on rest of surface. Posterior apophyses narrow, straight, slightly tortuous, about 3/4 length of papillae anales. Anterior apophyses long, almost 3 times as long as posterior apophyses, very thin, slightly bent at middle. Segment VIII of medium length dorsally, narrowing ventrally to 1/4 dorsal length, not fused ventrally, with short, oval, desclerotized section along anterior edge ventrad from base of apophyses, with higher concentration of scale (or setal) sockets. Sterigma forming short depression walled ventrally and laterally with sclerotized wire-like incomplete rings. Ductus bursae wide, short, with thin sclerotized dorsal and ventral, convex plate-like walls abutting each other, with ventral wall distally curving upward, and both plates followed by short sclerotized ridges continuing into corpus bursae. Corpus bursae slightly wider than ductus bursae, very long, about 12x length of sclerotized part of ductus bursae, with parallel margins, densely scobinated all over, without defined signum but with rounded plate of thicker scobination near distal end laterally.

Larva (Figs. 18–31). Based on one mature larva and five specimens representing earlier instars (including one cleared and dissected). Mature larval length 42 mm. Body pale with tonofibrillary platelets especially prominent on subdorsal and lateral areas of A6-8. Dorsal pinacula on A1-8 paler than surrounding cuticle; subdorsal to ventral pinacula on A1-8 distinctly paler than surrounding cuticle and slightly bulged; pinacula of A9 almost concolorous with cuticle; anal shield with a few patches of tonofibrillary platelets on posterior portion, also almost concolorous with cuticle. Spiracles on prothorax and A8 comparable in size, distinctly larger than spiracles on A1-7.

Head (Figs. 18, 21–28) light yellowish brown, without markings, more darkly pigmented at stemmata 3-5, clypeus, and



Figures 14–16. Male genitalia of *Myelobia heinrichi* (Box) holotype (USNM). **14.** Whole genitalia. **15.** Close-up of uncus. **16.** Close-up of phallus.

Figure 17. Female genitalia of *Myelobia nicaraguensis* sp. n.

around base of antenna. Front extending approximately one-half distance to epicranial notch. AF2 and AF1 widely spaced, AF2 well above apex of front, AF1 below it. F1 in line with the frontal pores. C1 and C2 equal in length. Labral setae in two groups of 3 setae, all more or less equal in length. P2 shorter and slightly posterodorsad of P1. A2 shorter than A1 or A3. L1 as long as A1. Six stemmata in semicircle, stemmata 1, 2 and 6 slightly larger than others, stemmata 3 and 4 closely spaced. S2 longer than S1, S3 between stemmata 5 and 6. SS2 longer than SS1 or SS3. Mandible with three obvious scissorial teeth and a small fourth one. Anterior mandibular seta longer and thicker than posterior one. Hypopharyngeal complex with thin spinneret rounded at apex longer than labial palpus, the dorsum covered with dense spines. Stipular setae present. Apical seta of antenna longer than basal segment. Maxillary palpus slightly longer than mesal lobe.

Thorax (Figs. 18, 28). Prothoracic shield nearly concolorous with head, without markings, and divided along midline. XD1, XD2 and SD1 in vertical line. SD2 much shorter than D1 or D2. Prespiracular pinaculum narrow, concolorous with shield, extending posteriorly below spiracle, with rosette of six tonofibrillary platelets present only on right side. L1 about four times as long as L2. SV group bisetose. V setae behind coxa and closely spaced, with length of each seta greater than distance between pinacula.

Mesothorax dorsally with wide triangular plate lacking setae on posterior edge of segment. D setae on oval pinaculum. SD2 short and slightly posterodorsad of SD1. L1 and L2 on small oval pinaculum. L3 short and on anterior edge of large circular pinaculum. SV group bisetose on large circular pinaculum. V setae closer to coxa than midline, on separate circular pinacula; distance between V1 on mesothorax approximately four to five times greater than separation of prothoracic V setae.

Metathorax dorsally with wide triangular plate similar to mesothorax but paler. Chaetotaxy as in mesothorax.

Abdomen (Figs. 18–20, 29–31). First abdominal segment. D1 on large circular pinaculum and about three times longer than shorter D1 seta. SD1 on large oval pinacula dorsad of spiracle. SD2 minute and anterodorsad to spiracle. L1 and L2 joined on same pinaculum, L3 longest of the group. SV group trisetose. V seta slightly closer to midline than to SV group.

Sixth abdominal segment. D setae on large oval pinacula, that of D1 slightly larger in diameter than D2. SD1 anterodorsal of spiracle. SD2 minute and anteroventrad of spiracle. L1 above L2, both joined on same pinaculum. L3 on elongate oval pinaculum. SV group trisetose, pinaculum indistinct. SV2 closer to SV3 than SV1. Crochets in irregular triordinal to weakly multiserial circle. V setae closer to coxa than midline.

Eighth abdominal segment. D1 pinacula and seta larger than D2. SD1 anterior to spiracle. SD2 minute, slightly anterior to SD1, below SD1 pinaculum, at level of ventral edge of spiracle. L1 and L2 joined on same pinaculum, both setae slightly posteroventrad of spiracle. L3 pinaculum about equal in size to L1-L2 pinaculum. SV group unisetose. V1 setae on A8 and A9 almost equally spaced.

Ninth abdominal segment. D1, D2 and SD1 nearly in vertical line. L1 unisetose and closer to SD1 than SV1. V1 on A9 twice as far apart as V1 setae on A10.

Tenth abdominal segment. Anal shield with D1 and SD2 aligned vertically. SD1 equidistant from D1 and SD2. Three L setae and one SV seta on outer side of anal proleg. Crochets irregular triordinal to weakly multiserial transverse arc.

Pupa (Figs. 32–39). Based on one exuvia (a female). Length 36 mm. Black brown on head, reddish brown on thorax dorsally, otherwise yellowish brown. Head heavily wrinkled, except for the smooth glazed eyepiece. Vertex narrow. Frons not produced. Invaginations for anterior arms of tentorium clearly indicated. Pilifers indistinct. Labrum an inverted truncated pyramid in shape. Antennae extending to slightly beyond half of forewing. Maxillary palpus small, triangular. Labial palpus concealed except for small triangular area. Maxillae extending to nearly middle of A2 and forewing. Prothoracic femur exposed, about half as long as rest of prothoracic leg; latter not reaching tip of maxillae and reaching slightly beyond middle of A1. Mesothoracic leg extending to about 3/4th length of forewing and about middle of A3. Metathoracic leg exposed, extending slightly beyond forewing and middle of A4, slightly separated apically. A4-6 ventrally with pair of proleg scars. Genital orifice on anterior portion of A8, without associated modifications of the cuticle. Anal orifice on A10 surrounded anteriorly by unmarked cuticle followed by 'crown' of short narrow grooves; laterally with 2-3 grooves along whole length of orifice and additional shorter grooves at apex; posteriorly with more grooves radiating from apex of orifice. Setae all very short: with one pair on prothorax just before mesothoracic spiracle; one pair on frontolateral lobes of metanotum; A1 bare; A2 and A3 with two pairs; A4 with four pairs; A5-7 with three pairs; A8 with four pairs; A9-10 with one pair. Mesothoracic spiracle long, slitlike. Cuticle of thorax and abdomen dorsally mostly smooth, with longitudinal creases, and with spinulose apical band of A4-6 all around these segments. Without lateral furrows on A10 or cremaster.

DNA Cytochrome oxydase I barcode (except first 66 base pairs) (GenBank accession number: BankIt1845402 MYELB001-15.COI-5P KT353043):

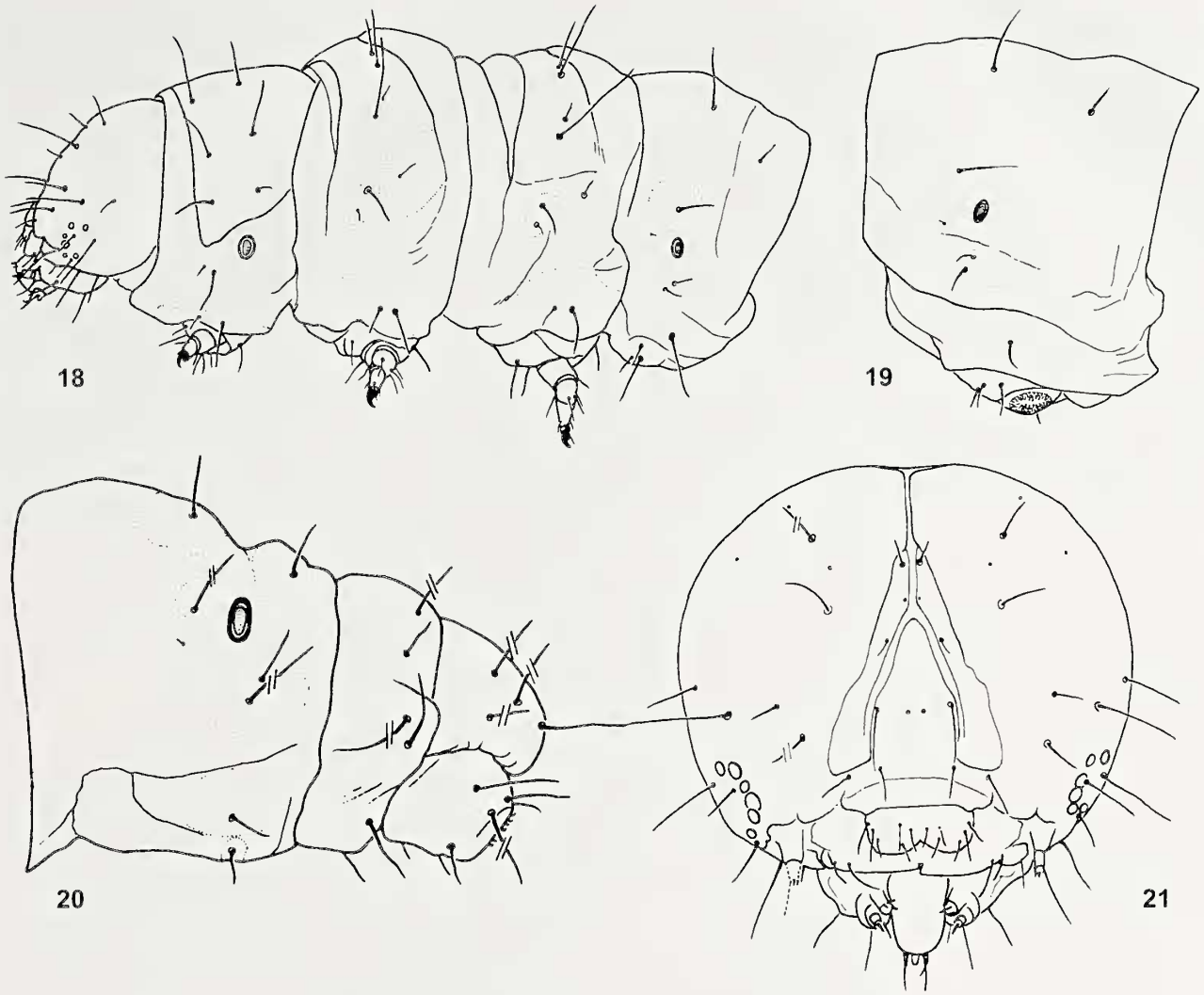
TGCAGAATTGGGTACCCCAAATTCTTTAATTGGTGATGATCAAATT
TATAATACAATTGTAACAGCTCATGCATTTATTATAATTTTTTT
TATAGTTATACCTATTATAATTGGTGGATTTGGAAATTGATT
AGTACCTTTGATATTGGGGGCTCCTGATATAGCTTTCCCTCGA
ATAAATAATATAAGATTTTGATTACTCCCCCCATCATTAACTCTTT
TAATTTCTAGAAGAATTGTTGAAAATGGAGCTGGAACTGGATGAA
CAGTTTATCCTCCTTTATCATCTAATATTGCCCATGGTGGAAGAT
CTGTAGATTTAGCAATTTTTTCTCTTCATCTAGCAGGAATTTCT
TCAATTTTAGGAGCTATTAATTTTATTACAACAATTATCAATATAC
GAATTAATGGGTTATCATTTGATCAAATACCTTTATTTGTTTGATCT
GTAGGAATTACCGCTTTATTACTTCTTTTATCTCTTCCAGTTT
TAGCTGGAGCTATTACTATATTACTAACAGATCGAAATTTAAACAC
CTCTTTTTTTGACCCTGCTGGAGGGGGGGATCCAATTTTATATCAA
CATTTATTT

Distribution. So far known only from the Bluefields (= El Rama) region of Nicaragua, on the Atlantic side. The type locality is 25 km east of El Rama or 36 km northeast of Bluefields.

Natural history. This species was reared from bamboo, *Guadua aculeata* Rupr. ex E. Fourn. (Poaceae). Apparently larvae attack only branches, not emerging shoots, and may wander from branch to branch. A more detailed account of the natural history of this species will be published in a forthcoming paper.

Discussion

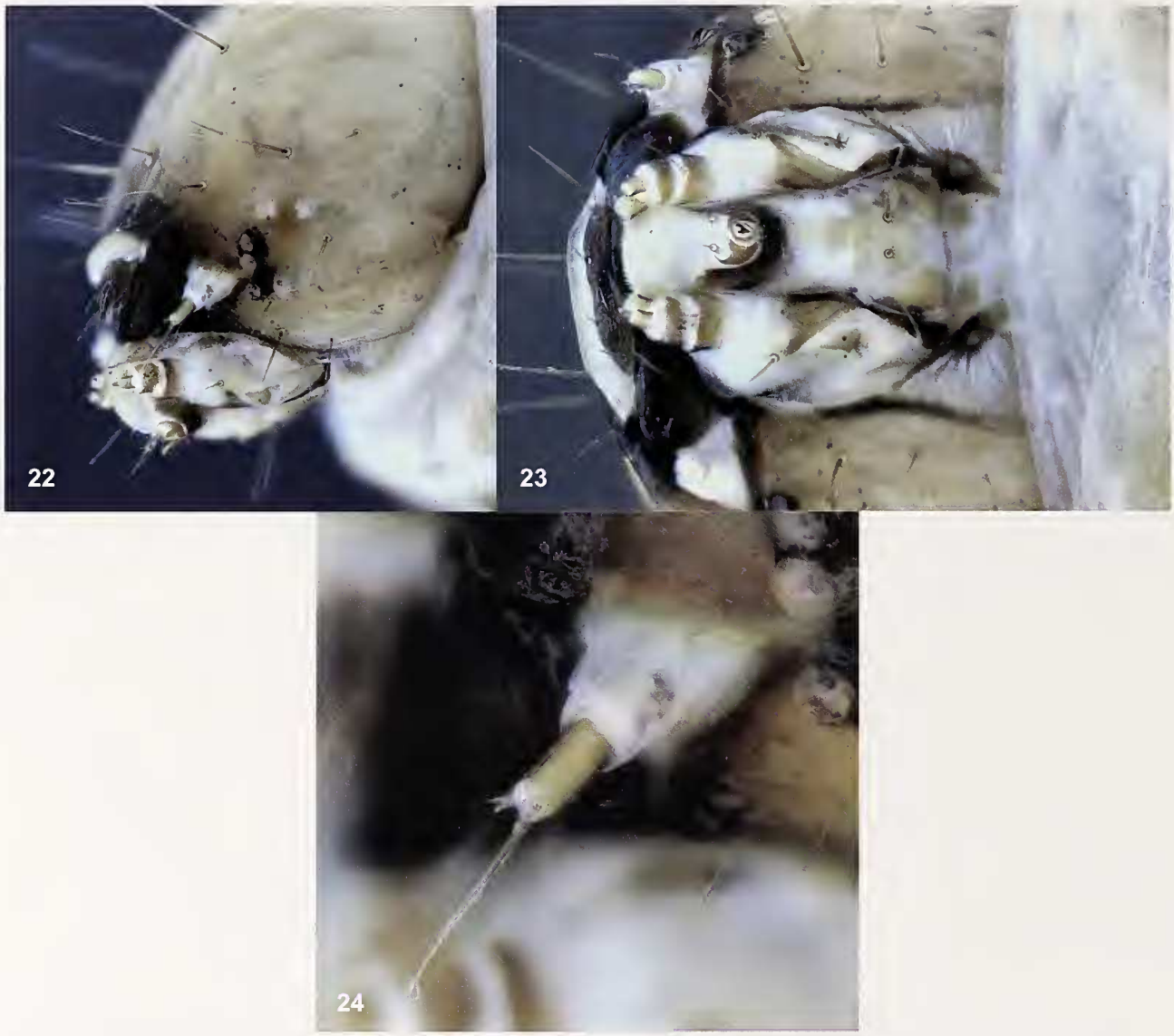
Landry (1995) based his characterization of *Myelobia* on only one species. The description of *M. nicaraguensis* differs from that summary in a few details, notably that the ductus bursae is differentiated in our new species. In addition to the holotype and the single paratype of *M. heinrichi* (Box) from Peru (Yahuarmayo, 365 m), BL examined an additional male specimen (BL slide 1805) of this species from Brazil (Rondonia, Cacaulândia, 140 m, xi.1991, V.O. Becker, coll. Becker 79589). The uncus of this specimen agrees with the holotype of *M. heinrichi*.



Figures 18–21. Mature larva of *Myelobia nicaraguensis* sp. n. **18–20.** Lateral view of head to A1 (**18**), A6 (**19**), A8–10 (**20**). **21.** Frontal view of head, slightly tilted to left.

Although information on *Myelobia* immatures is lacking for most species, there are several differences between the larva and pupa of *M. nicaraguensis* and *M. smerintha*, two species that may occur together on bamboo in Nicaragua. The larva of *M. smerintha* has the mesothoracic dorsum covered by a large plate that includes both the D and SD setae. This gives the impression of a larva with two "prothoracic shields" (Fig. 42). The mesothoracic plate of *M. nicaraguensis* is smaller, triangular and does not include either the D or SD setae (Figs. 18, 28). This is more typical of most crambine larvae that have a posterior shield on the mesothorax without setae (e.g. Allyson, 1986: 317). Another difference is in the height and shape of the SV pinaculum on A7 and A8. *Myelobia nicaraguensis* has a large elongate SV pinaculum that is approximately as high as the vertical diameter of the corresponding spiracle on that segment (Fig. 20). This contrasts with *M. smerintha* because the oval, not elongate, SV pinaculum on A7 and A8 is only half as high as the corresponding spiracle on that segment. Differences between the pupal stages are even more striking. The pupa of *M. smerintha* has the frons produced to a blunt point and the cremaster is a broad plate with two small points (Figs. 43, 44). In contrast, the frons is rounded in *M. nicaraguensis* and there is no trace of a cremaster (Figs. 32-34).

Landry (1995: 45, Fig. 4) included the genus *Myelobia* in his phylogenetic analysis of the Crambinae and suggested it was most closely related to *Diatraea*. Although no exclusive synapomorphy supported this relationship, the coecum penis was lost in the tribe Prionapterygini, the genus *Ancylolomia* and in both

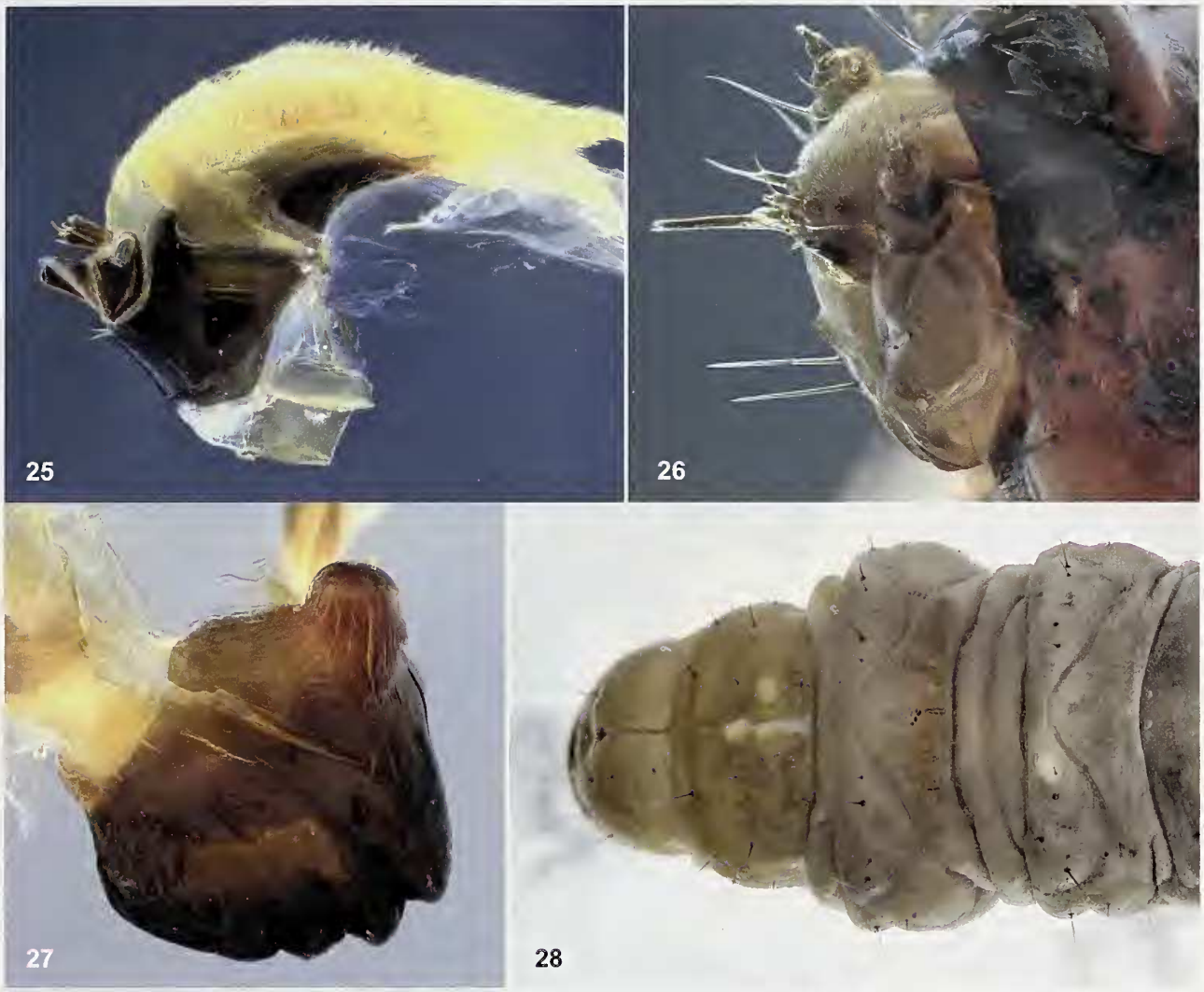


Figures 22–24. Head of mature larva of *Myelobia nicaraguensis* sp. n. **22.** Lateral view. **23.** Ventral view. **24.** Lateral view of left antenna.

Myelobia and *Diatraea*. We now have information on the genitalia of another *Myelobia* species (*M. nicaraguensis*) with preserved immatures for two members of this genus (*M. nicaraguensis* and *M. smerintha*). We can list several apparently overlooked characters of the immature stages that vary within the Crambinae and thus show promise for future morphological phylogenetic analyses. We have focused on Crambini, Argyriini (*Argyria* or *Urola*), Haimbachiini (*Eoreuma*) and economically important genera such as Chiloini (*Chilo*) and *Diatraea* for comparison because information on the immature stages is usually available in these taxa.

Egg morphology. There are two types of eggs in the Crambinae (Peterson, 1963). Crambini have eggs that are oval with obvious ridges (Matheny & Heinrich, 1972; Peterson, 1963). The eggs of *M. smerintha* (SPIC, Fig. 40), *Chilo* (e.g., Fletcher, 1914: Fig. 300; Peterson, 1963), *Eoreuma* (Johnson, 1981), *Urola* (Peterson, 1963) and *Diatraea* (Passoa, 1985; Peterson, 1963) are flattened and sometimes marked with a faint texture. The egg morphology of *Myelobia* is more similar to Argyriini (*Urola*), Haimbachiini (*Eoreuma*), Chiloini (*Chilo*) and *Diatraea* than Crambini.

Oviposition pattern. Eggs of the Crambini are laid singly without an adhesive (Peterson, 1963). The

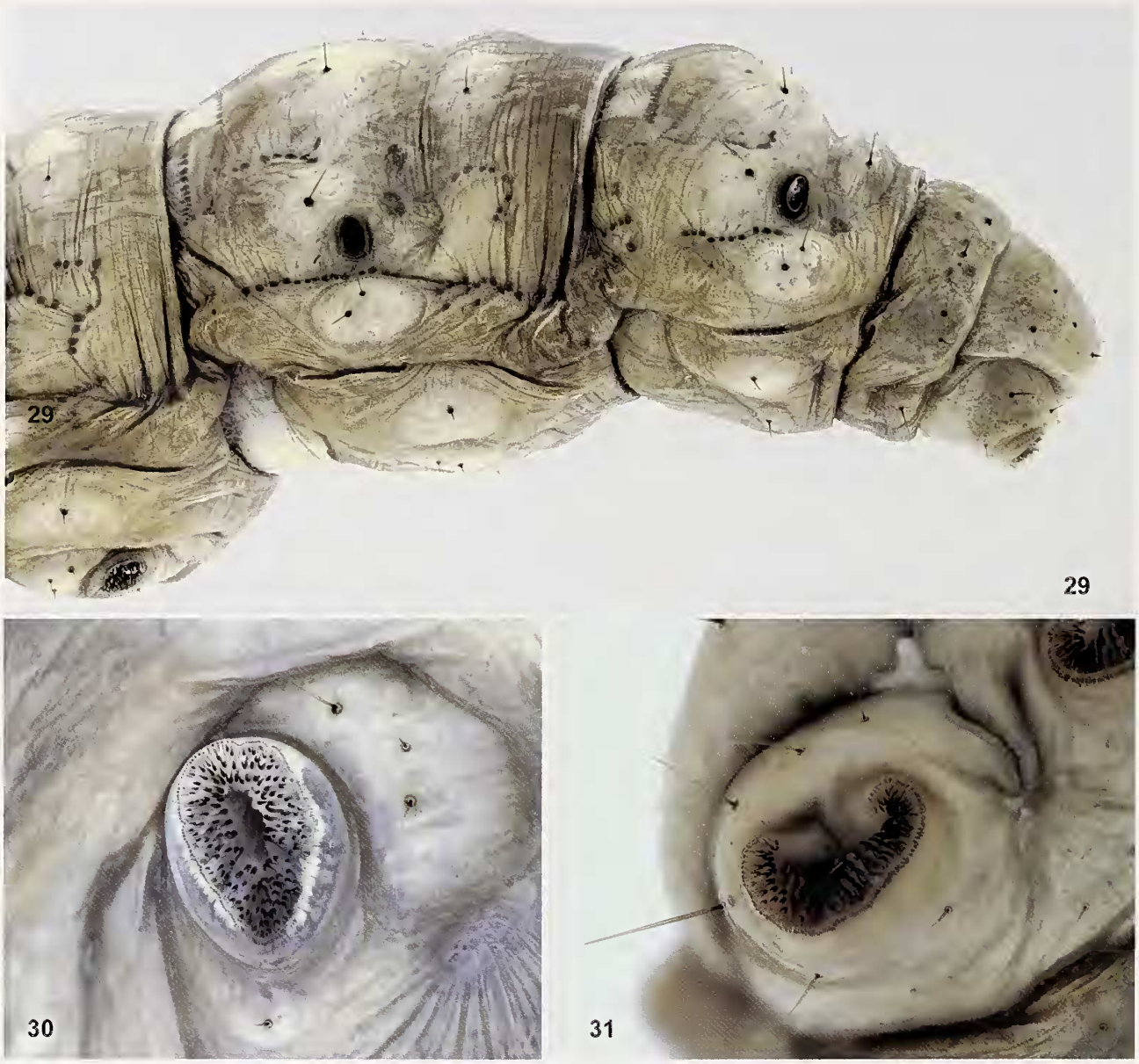


Figures 25–28. 25–27. Head of immature larvae of *Myelobia nicaraguensis* sp. n. **25.** Dissected hypopharynx, with spinneret and palpi broken (lateral view). **26.** Hypopharynx in situ of different larva, with spinneret entire (lateral view). **27.** Mandible (ventral view). **28.** Mature larva, head and thorax (dorsal view).

eggs of *M. smerintha* (SPIC), *Chilo* (e.g., Fletcher, 1914: fig. 300, Peterson, 1963), *Eoreuma* (Johnson, 1981), *Urola* (Peterson, 1963) and *Diatraea* (Passoa, 1985; Peterson, 1963) are laid in groups with an adhesive to prevent them from falling off the substrate. As with egg morphology, the oviposition behavior of *Myelobia* is more similar to that of Argyriini (*Urola*), Haimbachiini (*Eoreuma*), Chiloini (*Chilo*) and *Diatraea* than Crambini.

Mesothoracic and metathoracic SV setae. Crambini, *Argyria* (Allyson, 1986; Tan, 1984: 13), *Urola* (SPIC) and *Eoreuma* (Weisman, 1986) have a unisetose SV group on the mesothorax and metathorax. The SV group of *Myelobia* (*M. nicaraguensis* and *M. smerintha*) (SPIC, Fig. 19) and several *Chilo* and *Diatraea* (SPIC, Gilligan & Passoa, 2014) are bisetose in that position. This character groups *Myelobia* with Chiloini (*Chilo*) and *Diatraea* as opposed to the Argyriini or Crambini.

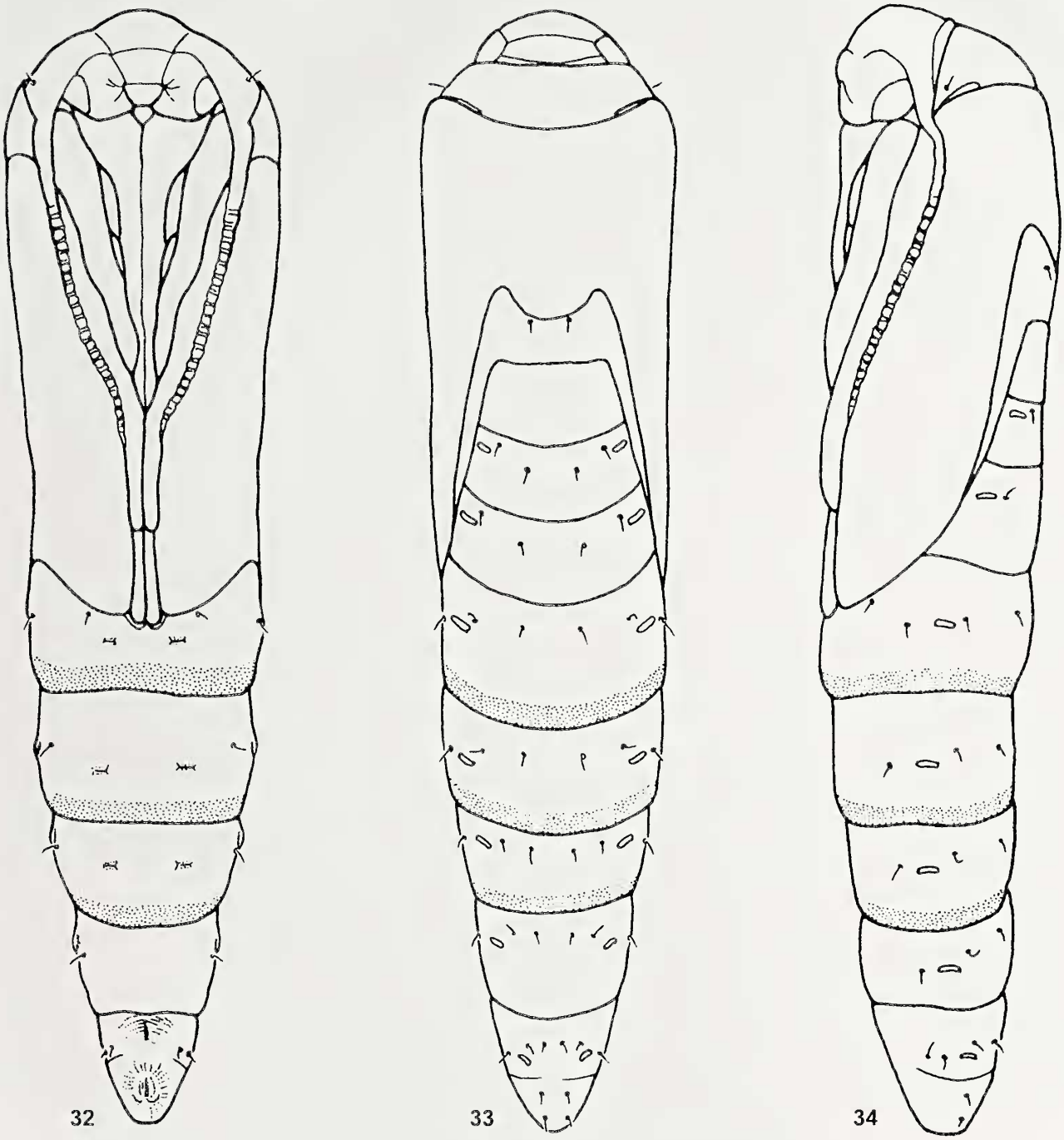
Pupal maxillae. Pupae of the Crambini have long maxillae that extend near the tip of the forewing (Passoa, 1985; SPIC). The maxillae of *Myelobia* (*M. nicaraguensis* and *M. smerintha*) (SPIC; Fig. 32), *Eoreuma* (Passoa, 1985) and several *Chilo* and *Diatraea* (SPIC) are short and only reach about half the forewing length. Both states exist in the Argyriini; *Argyria* has long maxillae (Passoa, 1985) whereas they are short in *Urola* (SPIC). This character groups *Myelobia* with the Haimbachiini (*Eoreuma*), Chiloini (*Chilo*) and *Diatraea*. Several other characters of



Figures 29–31. Mature larva of *Myelobia nicaraguensis* sp. n. **29.** Lateral view of A6-10. **30.** Left proleg of A3. **31.** Anal prolegs.

potential importance should be mentioned. The form of the cremaster is variable in the Crambinae (Passoa, 1985) but inconclusive with regard to the systematic position of *Myelobia*. A cremaster is absent in *M. nicaraguensis* but present in *M. smerintha*. The deep grooves found laterally on A10 in Crambini, *Chilo* (Passoa, 1985) and *M. smerintha* (SPIC) are absent in *M. nicaraguensis*, *Diatraea* and *Eoreuma*. The crochets of *Diatraea* and *Myelobia* are in a uniform circle (e.g. Fig. 29) as opposed to *Argyria* or *Eoreuma* that have the lateral crochets uniordinal and shorter in length than the longer triordinal mesal portion (Passoa, 1985). Although this character may well group *Myelobia* and *Diatraea*, not enough species have been studied to make a definitive statement.

In summary, there are some character states that associate *Myelobia* with *Diatraea*, the Chiloini and sometimes the Haimbachiini, but they should be put in a phylogenetic analysis together with molecular data to confirm any relationships. Characters of the immature stages strongly suggest *Myelobia* is not closely related to the Crambini. The description of



Figures 32–34. Pupa (based on exuvia) of *Myelobia nicaraguensis* sp. n. **32.** Ventral view. **33.** Dorsal view. **34.** Lateral view.

Figures 35–39. Exuvia of pupa of *Myelobia nicaraguensis* sp. n. **35.** Left mesothoracic spiracle. **36.** Apex of thorax ventrally. **37.** Left spiracle of A4. **38.** Spinulose apical band of A5. **39.** Ventral view of A8-10.

Figures 40–44. Immature stages of *Myelobia smerintha* (Hübner). **40.** Egg mass. **41.** Early instar, dorsal view. **42.** Mature larva, oblique dorsal view. **43.** Anterior half of pupal exuvia, lateral view. **44.** Cremaster, ventral view.

Table 1. Twenty best matches from the BLAST analysis of the barcode sequence of the *Myelobia nicaraguensis* sp. n. sample LEP2311 on all 3'742'723 barcode sequences available (>500bp). The name Crambidae in BOLD refers to a subgroup of Pyralidae s.l. as recognized here.

Family	Genus	Species	Similarity (%)	Sequence ID (when available)
Crambidae	*Corynophora*	*torrentellus*	91.67	AANIC081-10.COI-5P
Crambidae	*Corynophora*	*argentifascia*	91.67	AANIC082-10.COI-5P
Crambidae	*Corynophora*	*torrentellus*	91.67	ANICS202-11.COI-5P
Crambidae	*Corynophora*	*torrentellus*	91.5	AANIC079-10.COI-5P
Crambidae	*Corynophora*	*torrentellus*	91.5	ANICS203-11.COI-5P
Crambidae	*Corynophora*	*argentifascia*	91.33	ANICS206-11.COI-5P
Crambidae	*Myelobia*	*BioLep03*	91.16	BLPDM398-10.COI-5P
Pyralidae	-	-	91.16	LNOUF740-11.COI-5P
Crambidae	*Omiodes*	*continuatalis*	91.16	GBMIN22387-13.COI-5P
Crambidae	*Corynophora*	*torrentellus*	90.99	AANIC084-10.COI-5P
Crambidae	*Corynophora*	*torrentellus*	90.99	ANICS201-11.COI-5P
Crambidae	*Corynophora*	*torrentellus*	90.99	ANICS205-11.COI-5P
Crambidae	*Thliptoceras*	*manicalis*	90.91	-
Crambidae	*Massepha*	*grammalisDHJ01*	90.89	-
-	-	-	90.83	GMHGM157-13.COI-5P
Sphingidae	*Erinnyis*	*lassauxii*	90.82	LNOUE996-11.COI-5P
Crambidae	*Myelobia*	*BioLep03*	90.82	-
Crambidae	*Myelobia*	*BioLep03*	90.82	-
Crambidae	*Myelobia*	*BioLep03*	90.82	-
Crambidae	*Myelobia*	*BioLep03*	90.82	-

the mature larva and pupa of *M. nicaraguensis* and *M. smerintha*, being based on a single individual in each case, remains to be verified with more material for some of the fine details, especially of the pupal head region. Our descriptions of the *Myelobia* immatures are the first published for the genus except for a brief and unillustrated description of the larva of *M. smerintha* by Dyar (1917).

Molecular results. We obtained a 1378 base pair COI sequence, including 592 base pairs of the barcode region (90% coverage). The three best-matching sequences returned from the BOLD analysis (http://www.boldsystems.org/) belong to *Corynophora torrentellus* (Meyrick, 1879) (Pyralidae, Crambinae; 2 sequence matches) and *Corynophora argentifascia* (Hampson, 1919) (Pyralidae, Crambinae) from Australia with 91.67% similarity (see Table 1). The nearest *Myelobia* match is sample BLPDM398-10 from the Area de Conservacion Guanacaste in Alajuela, Costa Rica with 91.16% similarity. This latter sample most probably represents *Myelobia smerintha* (Hübner, 1821).

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Editor's note

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Literature cited

Allyson, S. 1986. Sod webworms: The larva of *Microcrambus elegans* (Clem.) (Pyralidae: Crambinae). Journal of the Lepidopterists' Society 40: 315–317.

Beccaloni G.W., A.L. Viloria, S.K. Hall & G.S. Robinson. 2008. Catalogue of the hostplants of the Neotropical butterflies. Sociedad Entomologica Aragonesa. Volume 8. Zaragoza, Spain. 536 pp.

Dyar, H.G. 1917. Descriptions of some lepidopterous larvae from Mexico. Insecutor inscitiae menstruus 5: 128–132.

Fletcher, T.B. 1914. Some south Indian insects and other animals of importance considered especially from an economic point of view. Government Press. Madras, India. 812 pp.

Gilligan, T.M. & S.C. Passoa. 2014. LepIntercept, an identification resource for intercepted Lepidoptera larvae. Identification Technology Program, United States Department of Agriculture Animal and Plant Health Inspection Service. Fort Collins, Colorado [accessed at www.lepintercept.org on 21 July 2015]

Janzen, D.H. & W. Hallwachs. 2009. Dynamic database for an inventory of the macrocaterpillar fauna, and its food plants and parasitoids, of Area de Conservacion Guanacaste (ACG), northwestern Costa Rica. [accessed at http://janzen.sas.upenn.edu on 21 July 2015]

Johnson, K.J.R. 1981. *Acigona loftini* (Lepidoptera: Pyralidae) in the lower Rio Grande Valley of Texas, 1980-1981. In the Vanguard Interamerican Transport Equipment Company. Second Inter-American Sugarcane Seminar, Insect and Rodent Pests -1981. Florida International University. Miami, Florida. 452 pp.

Kristensen, N.P. 2003. 4. Skeleton and muscles: adults. Pp. 39–131 *In*: Kristensen, N.P. (ed.), Handbook of zoology, Vol. IV, Part 36, Lepidoptera, moths and butterflies, Vol. 2, Morphology, physiology, and development. W. de Gruyter, Berlin, New York.

Landry, B. 1995. A phylogenetic analysis of the major lineages of the Crambinae and of the genera of Crambini of North America (Lepidoptera: Pyralidae). Memoirs on Entomology, International, Gainesville 1: 1–245.

Matheny, E.L. Jr. & E.A. Heinrich. 1972. Chorion characteristics of sod webworm eggs. Annals of the Entomological Society of America 65: 238–246.

Mosher, E. 1916. A classification of the Lepidoptera based on characters of the pupa. Bulletin of the Illinois State Laboratory of Natural History, Urbana, Illinois 12 (2): 17–153, pls. 1–27.

Müller J., K.F. Müller, C. Neinhuis & D. Quandt. 2011. PhyDE – Phylogenetic Data Editor. [Accessed at http://www.phyde.de on 21 July 2015]

Passoa, S. 1985. Taxonomy of the larvae and pupae of economically important Pyralidae in Honduras. Master's Thesis. University of Florida. Gainesville. 486 pp. [Accessed at http://idtools.org/id/leps/lepintercept/Passoa_1985.pdf on 21 July 2015]

Peterson, A. 1963. Egg types among moths of the Pyralidae and Phycitidae - Lepidoptera. Florida Entomologist, Suppl. 1, 9 pp., 5 pls.

Pogue, M.G. 2002. Identity of a sugar cane pest, *Scolecocampa mochisa* (Schaus), in Mexico, and a new generic synonym (Lepidoptera: Noctuidae). Annals of the Entomological Society of America 95: 653–657.

Ratnasingham, S. & P.D.N. Hebert. 2007. BOLD: The Barcode of Life Data System (www.barcodinglife.org). Molecular Ecology Notes 7: 355–364.

Regier, J.C., C. Mitter, M.A. Solis, J.E. Hayden, B. Landry, M. Nuss, T.J. Simonsen, S.-H. Yen, A. Zwick & M.P. Cummings. 2012. A molecular phylogeny for the pyraloid moths (Lepidoptera: Pyraloidea) and its implications for higher-level classification. Systematic Entomology 37: 635–656.

Stehr, F.W. 1987. Order Lepidoptera. Pp. 288–596 *In*: Stehr, F.W., Immature insects. Kendall/ Hunt Publishing Company, Dubuque, Iowa.

Tan, C.-L. 1984. Biology and taxonomy of sod webworms (Lepidoptera: Pyralidae) destructive to turfgrasses in Florida. University of Florida, Gainesville, Florida. Master of Science thesis. 121 pp.

Weisman, D.M. 1986. Keys for the identification of some frequently intercepted lepidopterous larvae. U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Plant Protection and Quarantine series 81–47. 64 pp.

Zhang, B.-C. 1994. Index of economically important Lepidoptera. Commonwealth Agricultural Bureaux International. Wallingford, United Kingdom. 599 pp.